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Arizona Corporation Commission
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**IN THE MATTER OF ARIZONA
PUBLIC SERVICE COMPANY-
APPLICATION FOR APPROVAL OF
CONCENTRATING SOLAR POWER
CONTRACT.**

DOCKET NO. E-01345A-08-0106

Comments of Western Resource Advocates

On February 21, 2008, Arizona Public Service Company [APS] filed an application for approval of a Purchased Power Agreement [PPA] to procure renewable energy from the proposed Solana power plant and for assurance of cost recovery. Under A.A.C. R14-2-1804[G], APS may ask the Commission to pre-approve agreements to purchase energy or renewable energy credits from eligible renewable energy resources. Western Resource Advocates [WRA] hereby submits its comments on the application.

The Solana power plant is a 280 MW concentrating solar power [CSP] generation project with thermal storage, to be developed by Arizona Solar One LLC and located near Gila Bend, Arizona. Service is expected to start during 2011. APS would purchase the entire energy output and renewable energy credits from the project over a 30 year period. APS estimates annual energy production to be 900,000 MWh [implying a 37% capacity factor]. Thermal storage would enable the project to generate electricity when the sun is not shining, e.g., in the evening during the summer when air conditioning load is very high.

Our comments provide the Commission with an independent assessment of APS' filing. WRA believes that the CSP project is a beneficial technological choice and that pre-approval of the PPA is in the public interest.

Evaluation of the Application

We believe that the Commission should apply a public interest test to APS' application. As explained below, there are five components to the public interest in this matter.

1. The PPA Contributes to Meeting APS' Renewable Energy Standard Requirements.

The proposed project will contribute to meeting APS' Renewable Energy Standard (RES) requirements. By 2012, APS will need to obtain 3.5% of its electricity from eligible renewable energy resources and in subsequent years APS will need to obtain a greater percentage of its electricity from renewable resources (A.A.C. R14-2-1804B). APS' retail sales in 2006 were 27,970 GWh. By 2012, retail sales would be about 33,400 GWh (assuming a 3% annual growth rate). With losses, generation requirements would be roughly 35,000 GWh in 2012. Therefore, APS would need to obtain about 1,225 GWh from eligible renewable resources to meet the RES requirements in 2012 and would need to obtain more renewable energy in later years.¹ The proposed project will contribute about 900 GWh per year and would be an important component of APS' renewable energy portfolio.

2. The PPA Advances the Commercialization of Concentrating Solar Power with Thermal Storage.

APS and other Arizona utilities will have to add significant new resources over the coming decade to meet the rapidly growing demand for electricity. But these new resources are likely to be quite different from those deployed over the last 50 years. Utilities must now address increasingly serious environmental impacts of power production from fossil fuels (for example, greenhouse gas emissions that contribute to climate change). In addition, utilities face enormous uncertainty over the costs and availability of fossil fuels, especially natural gas. Some of the technologies to be deployed are commercially available today, including wind energy, geothermal energy, biomass energy, and measures to improve energy efficiency. Emerging technologies, such as CSP with thermal storage, will also be part of the future resource portfolio.

Successful commercialization of emerging power generation technologies requires alignment of several factors (see Table 1).² The Solana project will advance the commercialization of CSP with thermal storage as discussed below.

- a. **Matching market demands.** CSP with thermal storage has major advantages for meeting load growth. It can provide power when APS needs it, and like other renewable energy resources and energy efficiency, it has the benefits of stable prices and no greenhouse gas emissions. Additionally, CSP with storage makes use of a plentiful resource – sunshine. In contrast, fossil fueled resources are risky because they face uncertain fuel costs and uncertain costs of complying with impending greenhouse gas emission regulations. The hedge value of CSP is discussed in Section 3 below.

¹ The Renewable Energy Standard is a minimum, not a ceiling on renewable energy.

² The first column of the table is based on U.S. Congress, Office of Technology Assessment, *Innovation and Commercialization of Emerging Technology*, OTA-BP-ITC-165, Washington, DC, 1995: pp. 49-60.

Table 1. Overview of Commercialization Factors for CSP

<i>Factor</i>	<i>Applicability to Solana</i>
Matching market demands	<ul style="list-style-type: none"> • Provides dispatchable generation • No CO₂ emissions • Stable price
Integration into existing grid and utility practices	<ul style="list-style-type: none"> • Generates electricity with steam power similar to conventional utility power plants • Dispatchable power
Meeting performance & reliability expectations	<ul style="list-style-type: none"> • Incrementally extends existing knowledge & experience with CSP • Does not require large leaps in technology
Learning by doing	<ul style="list-style-type: none"> • Experience in constructing and operating CSP plants may lead to lower costs
Scaling up	<ul style="list-style-type: none"> • Largest CSP plant with thermal storage to date • Scales up from lessons learned from Solar Two & European experience
Favorable financial conditions	<ul style="list-style-type: none"> • Pre-approval, cost recovery, extension of ITC
Regulatory approval	<ul style="list-style-type: none"> • Pending

b. **Integration into existing grid and utility practices.** René Kemp³ of the United Nations University – Maastricht Economic and Social Research Training Centre on Innovation and Technology has observed that “a new production technique ... must be incorporated into the existing production processes ... and must comply with diverse qualitative demands such as performance and user-friendliness.” CSP with thermal storage generates electricity using a technology familiar to Arizona utilities – steam. In addition, because of the thermal storage feature, the proposed project can generate power when it is most valuable to APS.

c. **Performance and reliability.** CSP technology makes incremental advances over current technology and does not require great leaps in engineering capability. Industry experience with CSP in the US and in Europe provides a

³ René Kemp, “An Economic Analysis of Cleaner Technology: Theory and Evidence,” in Kurt Fischer and Johan Schot, editors, *Environmental Strategies for Industry*, Washington, DC: Island Press, 1993: p. 85.

basis for solving practical deployment problems. At present there are three CSP plants in the Southwest:

- The 354 MW set of projects at Daggett, Kramer Junction, and Harper Dry Lake, California dating from 1985 to 1991. These projects use natural gas backup and produce electricity reliably.⁴
- APS' 1 MW Saguaro Solar Trough Power Plant completed in 2006.
- The 64 MW Nevada Solar One project near Las Vegas completed in 2007 which has a very limited storage capacity.

The next stage in CSP technology development is thermal storage that permits the power plant to generate electricity for several hours when the sun is not shining. Thermal storage has been successfully demonstrated at the Solar Two power tower project in Barstow, California⁵ and is being incorporated into several projects now under construction including the 100 MW Andosol project under construction in Spain.⁶

- d. **Learning by doing & scaling up.** The proposed project represents an opportunity for learning-by-doing in which industries make improvements in design, fabrication, installation, and operation of equipment. These improvements often lead to cost decreases over time.⁷ The experience with the Solar Two power tower provides specific examples of learning-by-doing, primarily dealing with solving unexpected problems.⁸ Progress is also made via economies of scale obtained with larger power plants and greater adoption of CSP.
- e. **Favorable financial conditions & regulatory approval.** As discussed below, pre-approval of the project and assured cost recovery are important to the viability of the project.

Commercialization of emerging technologies does not occur without early adopters. APS has stepped up to advance a highly promising technology. As described in the application, APS has also limited its risk exposure in doing so: it will pay only for energy delivered and it can make use of contractual off-ramps and penalty provisions if the project is not constructed on time or performs poorly.

⁴ Scott Frier, presentation at Central Solar Power Forum, Phoenix, AZ, January 10, 2008.

⁵ Hugh Reilly and James Pacheco, "Solar Two: A Successful Power Tower Demonstration Project," 2000 ASME International Solar Energy Conference, Madison, WI, June 17-22, 2000.

⁶ Rainer Aringhoff, presentation at Central Solar Power Forum, Phoenix, AZ, January 10, 2008.

⁷ Edward Rubin, Sonia Yeh, Matt Antes, Michael Berkenpas, and John Davison, "Use of Experience Curves to Estimate the Future Cost of Power Plants with CO₂ Capture," *International Journal of Greenhouse Gas Control* 1(2007): 188-197. Karin Ibenholt, "Explaining Learning Curves for Wind Power," *Energy Policy* 30 [October 2002]: 1181-1189.

⁸ Reilly and Pacheco, *op. cit.*

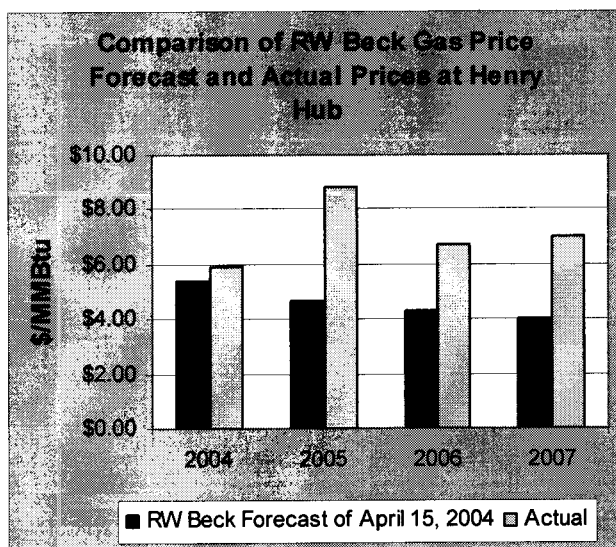
APS' application presents the Commission with an opportunity to foster a culture of innovation. However, rejection of APS' application for pre-approval could be seen by utilities, developers, and investors as a regulatory signal to avoid innovation, thereby delaying or locking out the commercialization of promising technologies in the Southwest.

3. The PPA Allows APS to Hedge Against Uncertain Natural Gas Prices.

CSP offers stable prices in contrast to highly uncertain natural gas prices and allows APS to hedge against high gas prices over the 30 year life of the contract.

The CSP plant would displace natural gas-fired generation, primarily from combined cycle power plants. As of March 19, 2008, futures prices for natural gas for the period April 2008 through December 2010 were in the range of about \$8 to \$10.25 per MMBtu.⁹ At this price range, the CSP project would enable APS to avoid capital, fuel, operating, and impending carbon dioxide emission regulation compliance costs of about \$119 to \$136 per MWh or \$0.119 to \$0.136 per kWh.¹⁰

Gas prices have been highly volatile and increasing over the past few years, so they may vary greatly from the range reported above. Looking out over 30 years, any projection of natural gas prices is highly speculative. The Energy Information Administration¹¹ has tracked forecasting errors in its *Annual Energy Outlook* for the period 1985 through 2005, comparing forecasted natural gas wellhead prices and actual wellhead prices. The average absolute percent error is 63.5%. As a second example of unreliable price projections, RW Beck's April 15, 2004 Henry Hub gas price forecast is shown in the figure. This forecast,



⁹ Prices are from NYMEX and pertain to delivery at Henry Hub. Prices that APS would pay would be slightly different because the delivery point is different and because APS would incur gas transportation costs. APS' actual prices in the next few years may also be different if APS' hedged gas at different prices.

¹⁰ The avoided gas generation is assumed to be a 280 MW combined cycle power plant with a 37% capacity factor, the same as the Solana project. Assumptions used to calculate gas generation costs in addition to the fuel costs specified above: heat rate = 7,600 Btu/kWh; variable operating and maintenance costs of \$2.05 per MWh; fixed operating and maintenance costs of \$12.44 per kW per year; carbon dioxide emission regulation compliance costs of \$20 per metric ton of carbon dioxide; a carbon dioxide emissions rate = 0.39 metric tons per MWh; capital costs for a new combined cycle power plant of \$950 per kW, and a capital recovery factor of 15%.

¹¹ Energy Information Administration, *Annual Energy Outlook Retrospective Review: Evaluation of Projections in Past Editions (1982-2006)*, DOE/EIA-0640(2006), Washington, DC, 2007, Table 2.

by a well known firm, completely missed the mark. With errors of this magnitude, any claim that gas-fired generation would be cheaper over the long run than the CSP project is unsupportable. In this respect, we disagree with APS (application pp. 4, 5, & 7) that there is a cost premium associated with the PPA relative to conventional generation – the existence of any future cost premium over a 30 year time horizon is at present unknowable.

In contrast to this pervasive uncertainty about future gas prices, a major benefit of the PPA is its stable and predictable price. APS represents that the pricing in the PPA "... is defined, with a modest fixed escalation over the term of the agreement, eliminating any uncertainty in cost" (p. 4).

4. The PPA Diminishes APS' Greenhouse Gas Emission Regulation Compliance Costs.

The PPA reduces APS' costs of complying with impending greenhouse gas emission regulations. Under the assumptions described above, the CSP project would avoid about 350,000 metric tons of carbon dioxide emissions per year (more if less efficient gas-fired power plants or coal-fired power plants are displaced by the project). It is expected that Congress will regulate greenhouse gas emissions (including carbon dioxide) starting around 2012. Estimates of compliance costs vary greatly, but for illustrative purposes, if compliance costs were \$20 per metric ton of carbon dioxide equivalent, the proposed project would save APS and its ratepayers about \$6.9 million per year or about \$0.0077 per kWh of solar energy.¹²

5. Pre-Approval of the PPA Is a Reasonable Risk Management Technique.

The Office of Technology Assessment¹³ concluded that "Commercialization is a business decision based on reasoned [judgments] about future returns from investments in product design and development, manufacturing, marketing, and distribution." Commercialization of CSP requires, among other things, managing the risk of cost recovery for early adopters. New technologies are unlikely to be the cheapest resource available at the time and may experience performance problems during start-up activities. Under traditional utility regulation, recovery of costs in excess of market costs or costs incurred to solve operational problems may be disallowed, thereby making early adoption of emerging technologies riskier for utilities than continued deployment of conventional power generation technologies, even though conventional power generation technologies may be more costly in the long run.

Regulators must balance the need to encourage new technologies with their role of protecting ratepayers from managerial misjudgments. One way this balance can be accomplished is for the Commission to: 1) carefully review new technologies, 2) pre-

¹² These cost savings are included in the avoided costs presented in Section 3 above.

¹³ U.S. Congress, Office of Technology Assessment, *Innovation and Commercialization of Emerging Technology*, OTA-BP-ITC-165, Washington, DC, 1995, p. 95.

approve utility plans to deploy promising new technologies prior to the utility acquiring the technology, and 3) review project progress and operation on an ongoing basis.¹⁴

Several observers recommend regulatory pre-approval and full cost recovery for emerging technologies such as those with improved environmental performance. Examples are listed below:

- The Advanced Coal Task Force of the Western Governors' Association Clean and Diversified Energy Initiative supported resource pre-approval and full cost recovery as an incentive for improving the operational and environmental performance of advanced coal technologies, provided that the utility take appropriate steps to manage costs and risks. Incentives are needed to overcome the higher cost and risks experienced by early adopters in order to commercialize and reduce the costs of advanced technologies.¹⁵
- A recent NARUC report¹⁶ on emerging technologies to capture and store carbon dioxide emissions from fossil-fueled power generation noted that "regulators may want to consider ensuring pre-approval of cost recovery including construction costs. Such action can lead to a lower overall cost of capital and less rate shock when the construction is completed."

In addition, as indicated above, APS has incorporated provisions in the purchased power agreement to limit its exposure to risks of poor performance. In particular APS indicates (Application Exhibit A) that:

- Arizona Solar One must meet a pre-set construction schedule or take actions to complete the project on time or pay damages to APS.
- The agreement may be terminated if commercial operation does not occur within 50 months of Commission approval.
- The project must meet minimum annual output levels and minimum peak capacity levels or else Arizona Solar One must pay damages to APS.
- The agreement may be terminated by APS if the solar power plant chronically under-performs.
- Arizona Solar One cannot schedule planned outages during the summer.

Given the long term of the PPA, the disincentives for innovation under traditional regulation, the benefits of the Solana project, and the contractual limitations on

¹⁴ The Commission has begun moving toward a policy of encouraging environmental improvements. In Decision No. 69663 pertaining to an APS rate case, the Commission stated (p. 86) that "... APS should be proactive rather than reactive on issues of environmental improvement." In that order, the Commission authorized APS to establish an account funded by a surcharge (the Environmental Improvement Surcharge) for funding mandatory or voluntary environmental improvements, such as pollution reduction equipment on power plants.

¹⁵ Western Governors' Association, Clean and Diversified Energy Initiative, *Advanced Coal Task Force Report*, January 2006, pp. 3-5.

¹⁶ National Association of Regulatory Utility Commissioners, "Carbon Capture & Storage: Technological and Regulatory Considerations," March 2008, p. 12.

performance risk, it is reasonable for the Commission to pre-approve the PPA and to assure cost recovery for APS.

Conclusions and Recommendations

The Solana project is in the public interest:

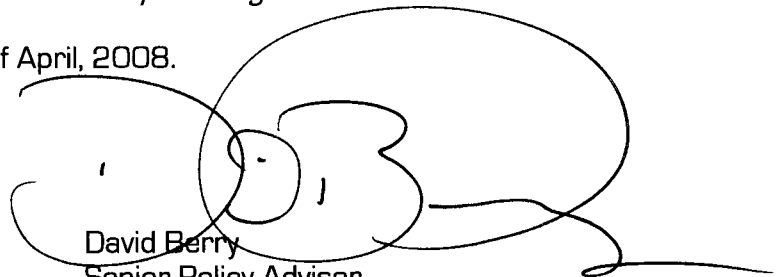
- It contributes to meeting APS' renewable energy standard requirements.
- It advances the commercialization of concentrating solar power with thermal storage.
- It allows APS to hedge against uncertain natural gas prices.
- It diminishes APS' greenhouse gas emission regulation compliance costs.

In addition, pre-approval of the PPA is a reasonable risk management technique.

Therefore, WRA recommends that the Commission pre-approve the PPA to procure renewable energy and credits from the Arizona Solar One CSP project and assure APS of cost recovery. WRA recommends that the Commission's order in this case include the following language:

APS shall be entitled to recover from ratepayers the payments made for delivery of electric energy to APS (for retail sale) from the Solana Generating Station. APS shall propose for Commission review a specific cost recovery mechanism, supported by cost and other pertinent information, prior to the time it wishes to start recovering such costs. In addition, APS shall include in its annual compliance reports required by A.A.C. R14-2-1812 (the Renewable Energy Standard rules) a supplemental discussion of progress in construction and early operation of the Solana plant, identifying any major problems and setting forth solutions to those problems. Provision of this supplemental information may be discontinued at the time the Solana plant reaches commercial operation or if the project is canceled or terminated and APS has no further obligations under the purchased power agreement.

Respectfully submitted this 30th day of April, 2008.



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